

PROJECT ADMINISTRATION DATA SHEET



ORIGINAL



REVISION NO. _____

Project No. A-3065DATE 11/19/81Project Director: Mr. W. J. Steinway~~School~~ Lab RAIL/RADSponsor: Gulf Interstate Engineering Company, Houston, TX 77027Type Agreement: Purchase Order No. U0981-315Award Period: From 9/22/81 To 10/15/81 (Performance) _____ (Reports) _____Sponsor Amount: \$5,000 Contracted through: _____Cost Sharing: None GTRI/GIT ~~xxx~~Title: Consultation and Assistance in Development of the Pulse Radar System

ADMINISTRATIVE DATA

OCA Contact William F. Brown x4820

1) Sponsor Technical Contact:

Bijon AminiHydrodynamics & Technological Research, Inc.c/o Gulf Interstate Engineering Co.P. O. Box 56288Houston, TX 77027

2) Sponsor Admin/Contractual Matters:

Mr. B. P. LaFitte, Purchasing AgentHydrodynamics & Technological Research, Inc.c/o Gulf Interstate Engineering Co.P. O. Box 56288Houston, TX 77027(713) 850-3510Defense Priority Rating: NoneSecurity Classification: none

RESTRICTIONS

See Attached N/A Supplemental Information Sheet for Additional Requirements.

Travel: Foreign travel must have prior approval — Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of \$500 or 125% of approved proposal budget category.

Equipment: Title vests with sponsor; however none authorized/proposed

COMMENTS:

Please notify OCA when work is completed.

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GEORGIA INSTITUTE OF TECHNOLOGY

OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION/CLOSEOUT SHEET

Date 3/15/84

Project No. A-3065

~~XXXX~~/Lab RAIL-DD

Includes Subproject No.(s) _____

Project Director(s) Dr. W.J. Steinway (no longer at Georgia Tech)

GTRI / ~~GXX~~

Sponsor Gulf Interstate Engineering, Co., Houston, Tx.

Title Consultation and Assistance in Development of the Pulse Radar System

Effective Completion Date: 6/1/83 (Performance) 6/1/83 (Reports)

Grant/Contract Closeout Actions Remaining:

☒ None

☐ Final Invoice or Final Fiscal Report

☐ Closing Documents

☐ Final Report of Inventions

☐ Govt. Property Inventory & Related Certificate

☐ Classified Material Certificate

☐ Other _____

Continues Project No. _____

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ENGINEERING EXPERIMENT STATION
Georgia Institute of Technology
A Unit of the University System of Georgia
Atlanta, Georgia 30332

12 May 1982

Mr. Bijan Amini
Senior Vice President
Gulf Interstate
1233 West Loop South
P. O. Box 56288
Houston, TX 77027

Subject: Monthly Contract Technical Status Report No. ¹/₃
"Buried Pipe Detection" Project No. A3065, Covering
the Period of April 1982

Gentlemen:

This monthly status report indicates the activities on the Buried Pipe Detection project for the month of April, 1982. The major activities during April consisted of a demonstration in Houston, Texas with the void detection radar, the layout design and start of the single antenna system mounted in a pickup truck and continued design and construction of the tri-static detection and tracking system. The expenditure curve for the month of March is included in this report.

Void Detection Radar

The void detection radar was reassembled and made operational for a demonstration at Houston on April 19, 1982. A few small modifications were necessary to the void detection radar to make ready for the demonstration. The GSSI strip recorder was interfaced to the radar. To interface, it was necessary to synchronize the recorder to the radar which required an external clock and timing circuit to be designed and integrated with the system. Power supply cables and an antenna cable were also rebuilt. The system was made operational and then torn down and packaged for shipment to Houston. The radar equipment was sent to Houston by small plane. Concrete slabs necessary for the measurement demonstration were transported to Houston via truck. The demonstration took place on April 19. Afterwards the equipment was disassembled and returned to Georgia Tech.

Truck Mounted Single Antenna Pipe Tracking System

The single antenna pipe tracking system, which previously had been mounted on a small electric garden tractor, was disassembled and made ready to be mounted on a four-wheel drive pickup truck. A layout design was completed which determined the placement and mounting of the various components of the system. Components such as the Apple Computer, printer and signal conditioning unit were shock-mounted to withstand road shock and vibration. The GSSI equipment, power supplies and other miscellaneous equipment will be hard-mounted. All components will be strapped in place for minimum movement. The antenna will be mounted on pivot arms off the rear of the truck. Vertical raising and lowering of the antenna is controlled by a winch. The antenna platform is designed such that the antenna is only mounted on the platform during measurement taking conditions. During vehicle transport the antenna should be removed from the platform. Approximately 80% of the construction was completed for installing the single antenna system on the pickup. The remaining construction and assembly will be completed early in May.

Tri-Static System

A hardware design review was held on April 6 for the signal conditioning unit and the tri-static control unit. The design of the two units was presented. Minor changes to the units resulted from the design review and a go-ahead was given to start construction. The two units will be packaged within the same chassis, known as the Data Acquisition Module. Digital board No. 1 for the signal conditioning unit and the digital board for the tri-static control unit were built. The control panel for the data acquisition module has been fabricated. The analog board has been started. Completion of the analog board, digital board No. 2, and assembly of the control panel should be completed in May.

A software design review was held on April 28, 1982. The top level software hierarchy diagrams were presented and discussed. It became apparent that detail was insufficient for a design review and so the design review was re-scheduled for May 19.

The receiver sampler breadboard was constructed. The receiver is working but testing is still in progress. The gain switch circuit was constructed and is presently being tested.

The testing of the breadboard transmitter was completed. Test data indicates that the power output for the breadboard is approximately 180 watts. The pin diode circuit used in the transmitter design switching speed looks good. Design of the three transmitters to be used in the tri-static system was started - packaging and interfacing are major considerations.

General

The funding expenditure for the month of March is shown in Table 1. Table 1 also includes total dollars spent. The schedule for the tri-static buried pipe system is included. Presently this effort is approximately one month behind schedule. The void detection radar demonstration is the primary reason for schedule alterations.

Respectfully,

W. J. Steinway
Project Director

Approved:

Charles E. Brown
Chief, RD

WJS:MOH

TABLE 1
Expenditures for March

	<u>March</u>	<u>Total</u>
Personal Services	24731	93886
Materials & Supplies	2667	22940
Travel	<u>1188</u>	<u>184430</u>
Total	52905	184430

BURIED PIPE DETECTION - PROJECT A-3065

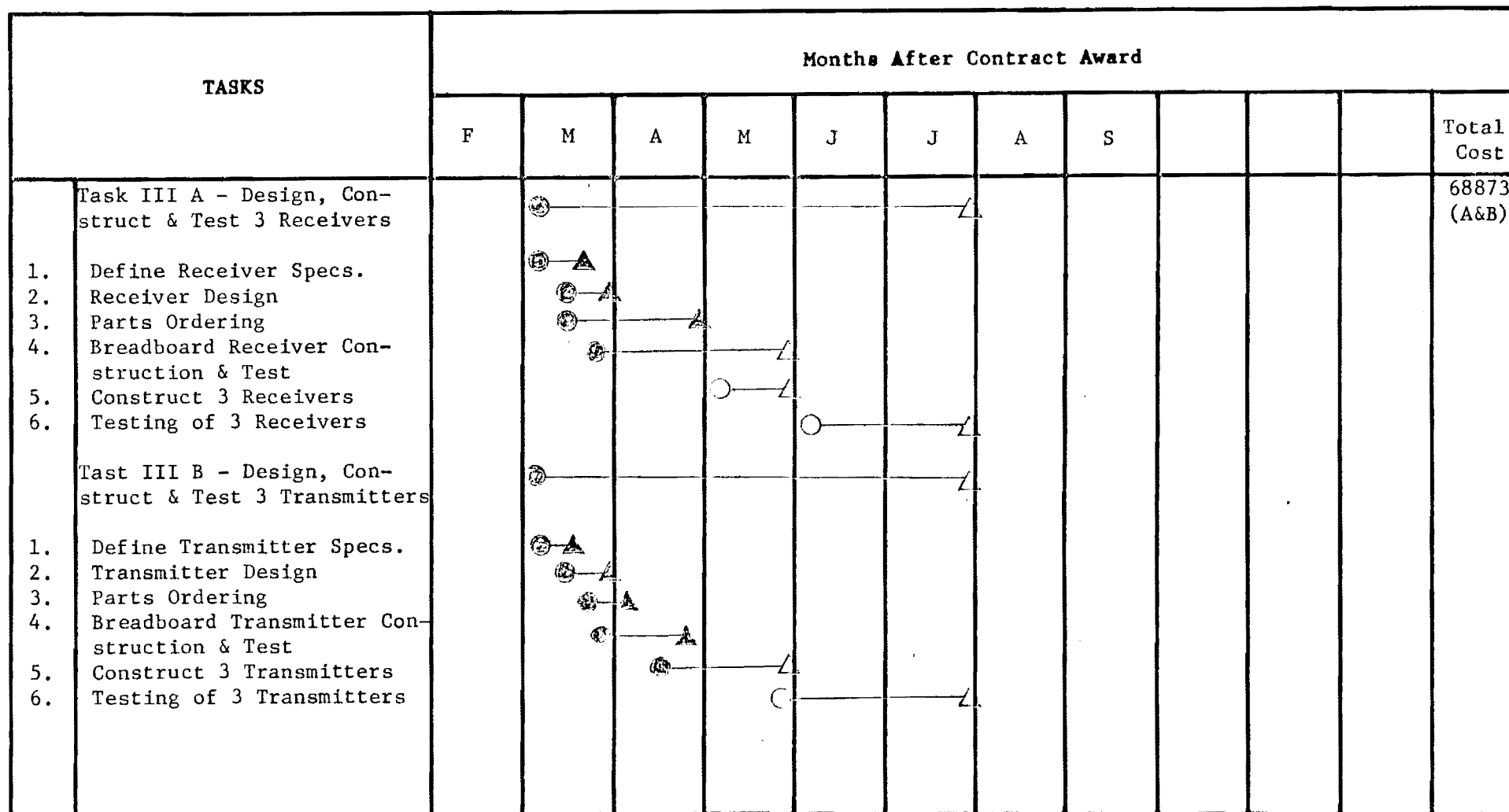
TASKS		Months After Contract Award											Total Cost
		F	M	A	M	J	J	A	S				
	Task I - Construct & Tune 3 Antennas		③		△		△						54332
1.	Purchase Materials		③△										
2.	Cut & Assemble 3 Structures		④	△									
3.	Tune Antennas			⑤	△		△						
4.	Fiberglass Antennas				○△		○△						
	Task II - Tri-Static Control Unit Design, Construct & Test		⑥		△		△						36360
1.	Define Requirements & Interface to Existing Equipment		⑥△										
2.	Control Unit Design		⑦	△									
3.	Ordering of Parts		⑧	△									
4.	Construction of Control Unit			⑨	△		△						
5.	Control Unit Test & Interface w/Other System Components				○	△	○△						

○ Task Start

○—△ Task Duration

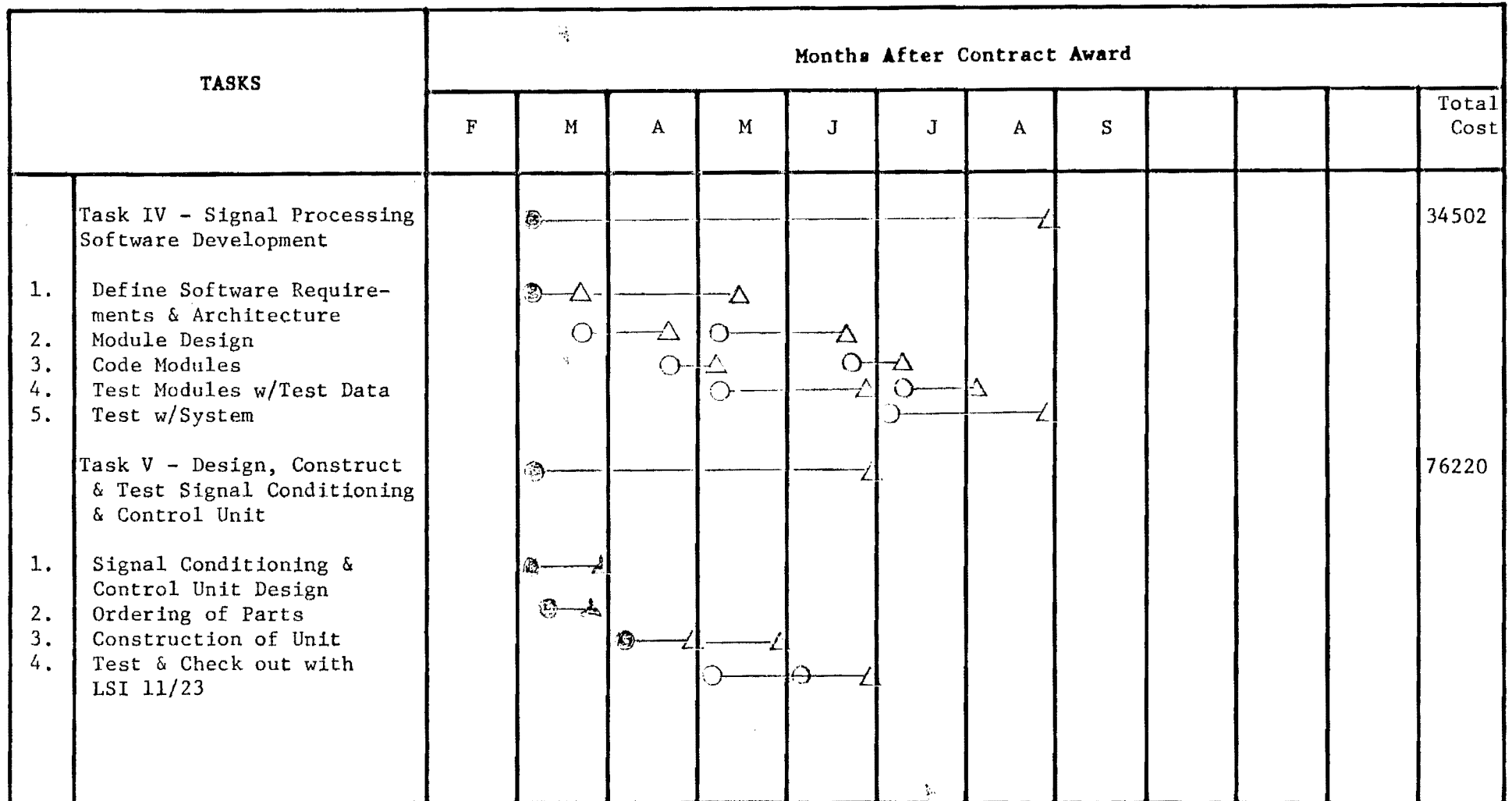
△ Task End or Major Milestone

BURIED PIPE DETECTION - PROJECT A-3065



○ Task Start ○—△ Task Duration △ Task End or Major Milestone

BURIED PIPE DETECTION - PROJECT A-3065



○ Task Start ○—△ Task Duration ▲ Task End or Major Milestone

BURIED PIPE DETECTION - PROJECT A-3065

TASKS		Months After Contract Award											Total Cost
		F	M	A	M	J	J	A	S				
1.	Task VI - Tri-Static Radar System Integration					○	—△						28396
	1. System Mechanical Integration					○	—△						
	2. System Electrical Tests						○△						
3.	System Tests						○△						
1.	Task VII - Tri-Static Radar System Field Test						○	—△					68107
	1. Test Site Preparation						○△						
	2. System Test							○	—△				
3.	Data Collection & Analysis							○	—△				

○ Task Start

○—△ Task Duration

▲ Task End or Major Milestone

ENGINEERING EXPERIMENT STATION
Georgia Institute of Technology
A Unit of the University System of Georgia
Atlanta, Georgia 30332



9 June 1982

Mr. Bijan Amini
Senior Vice President
Gulf Interstate
1233 West Loop South
P. O. Box 56288
Houston, Texas 77027

Subject: Monthly Contract Status Report No. ²~~4~~ "Buried Pipe Detection",
Project No. A-3065; covering the period of May 1982.

Gentlemen:

This monthly status report indicates the activities on the Buried Pipe Detection project for the month of May, 1982. The main activities during May consisted of completion of the prototype design for the single antenna system mounted in a pick-up truck, insertion of a preliminary 180 watt transmitter into that system, testing of the unit in Tucson, Arizona, initialization of construction of a second, single-antenna unit and continuation of the tri-static unit construction. An expenditure tabulation for the project is included.

Truck Mounted Prototype System

All components for the pipe tracking system were mounted in the camper shell on the truck. Components were either firmly tied down or shock-mounted. The system was released for shipment to Houston on 21 May.

Included on that system was a preliminary version of a 180 watt transmitter. The transmitter tested out well at the Georgia Tech facility prior to shipment. As a temporary measure, batteries were installed as a power source. Standard power supplies will be installed in the near future.

Single Antenna Pipe Tracking System #2

Construction of a second signal conditioning unit to interface with an Apple computer has begun. This second unit will be similar in design to the first but will have the capability to expand from 4 circuit boards to 9. Drawings have been sent to the machine shop for enclosure fabrication. Two of the digital boards have been wired.

After the system test at Tucson, it became apparent that there was a need to add a surface track circuit. This surface tracker would make it possible to filter clutter in real-time. The initial design review indicates the optimum choice for surface tracking is a digital split-range-gate tracking system. The recursive clutter filter would employ an averaging technique with an adjustable time constant. The addition of these circuits will be a major hardware modification which should produce a significant improvement in system performance. A comprehensive circuit design has begun.

Antenna Tuning and Fabrication

The prototype antenna (Antenna No. 1) was delivered to the field with the complete system for testing. Antenna No. 2 has been tuned for both feed and end reflections. The feed reflection is approximately 30 dB below the transmitter pulse and the end reflection is approximately 27 dB below the transmitter pulse. Final mechanical connections for the stiffener plate of the feed end of the antenna and connections between the resist cards and the antenna end are being completed. The antenna should be completed, including the application of fiberglass coating by 15 June.

Emphasis has been shifted from completing the third, 12-foot long antenna to finishing construction of an 8-foot antenna. It is expected that tuning of the 8-foot antenna will be completed during the month of June and the complete fibreglassed antenna should be ready by mid-July.

Tri-Static System

Mechanical construction of the Data Acquisition Module, including enclosure modification, rear access panel fabrication, and front panel engraving, has been completed. The front panel, back plane, and analog board have been partially wired. The completion of Digital Board No. 2 and checkout of the entire unit have been delayed to allow personnel to build a replica of the signal conditioning unit that has been delivered.

The Tri-Static Control unit digital board has been designed, built, tested and is fully operational. This circuit will multiplex the transmit signal to one of three transmitters and choose the correct receiver channel as directed by front panel or computer control. It will also generate the real-time gain control signal for the Georgia Tech receiver, and is able to change the gain in one sec steps from 25 to 280 sec.

Considerable progress has been made in the area of software design since the last report. Several important details previously in question have been resolved. The top level software hierarchy is completed and the lower levels

Progress Report
A-3065

- 3 -

9 June 1982

presently are being developed in detail. Specifically, a pipe and a surface tracking algorithm have been defined as well as control and display functions. Coding will begin as soon as all levels are defined.

Respectfully,

William J. Steinway
Project Director

Approved:

Charles E. Brown,
Chief, Radar Development Division
Radar & Instrumentation Laboratory

WJS:mh

Table 1

Expenditures for Month of April 1982

	<u>April</u>	<u>Total</u>
Personal Services	\$27,565	\$119,551
Retirement	3,006	13,020
Equipment	-	1,195
Computer	-	336
Material & Supplies	10,662	30,380
Travel	3,050	5,767
Overhead	<u>23,481</u>	<u>87,151</u>
TOTAL	\$67,764	\$257,400



ENGINEERING EXPERIMENT STATION
Georgia Institute of Technology
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Atlanta, Georgia 30332

15 July 1982

Mr. Bijan Amini
Senior Vice President
Gulf Interstate
1233 West Loop South
P. O. Box 56288
Houston, Texas 77027

Subject: Monthly Contract Status Report No. 3, "Buried Pipe Detection",
Project No. A-3065; covering the period of June 1982.

Gentlemen:

This monthly status report indicates the activities on the Buried Pipe Detection project for the month of June 1982. The main activities during June consisted of the development of 80 and 120 megahertz transmitters, completion and delivery of an acoustic ranging device, fabrication and testing of an eight foot antenna, and fabrication of a second signal conditioning unit.

Transmitter Development

Development of two new transmitters was assigned a high priority during the reporting period. A lower frequency transmitter than 300 megahertz was needed to increase depth of signal penetration into the ground. An 80 megahertz transmitter was built prior to developing the 120 megahertz transmitter. Testing of the 120 megahertz transmitter indicates a pipe buried at a depth of 9 feet can be detected in extremely wet clay soil. This sensitivity was not achieved with any previous system configuration.

The present power supplies for the transmitter will have to be replaced because of intolerable noise levels. Measurements will be completed using batteries.

Acoustic Ranging Device

An acoustic ranging device was developed and fabricated for applications such as oil tank capacity measurements. The device operates at 40 kilohertz with a measured maximum range of 200 inches and display resolution of 0.1 inches. A six inch square box houses the unit which features LED readout displays that update automatically.

15 July 1982

Improvements such as a directive transducer will be investigated. A larger transducer could reduce the beamwidth from 30 degrees to 5 degrees which would produce a 13 dB improvement in signal to noise ratio.

Antenna Tuning and Fabrication

The eight foot antenna (antenna No. 3) is ready for final checkout before applying the fiberglass. Feed and tip reflections have been tuned to better than 30 dB reflection coefficient. The stiffener plate and modified SMA connector were attached and the styrofoam form is completed.

Single Antenna Pipe Tracking System #2

Mechanical construction of a second signal conditioning unit to interface with an Apple computer has been completed. This second unit will have surface track capability and a real-time clutter filter. The final design of the unit includes six circuit boards of which five have been wired. Testing and troubleshooting of the digital circuits has begun.

Truck Mounted System

Steel angle supports have been attached to the truck for support of an air conditioner and generator which have been ordered. A new antenna mount has been constructed with fiberglass members.

Respectfully,

for
William J. Steinway
Project Director

Approved:

Charles E. Brown,
Chief, Radar Development Division
Radar & Instrumentation Laboratory

WJS:mh

A-3065

ENGINEERING EXPERIMENT STATION
Georgia Institute of Technology
A Unit of the University System of Georgia
Atlanta, Georgia 30332

12 August 1982

Mr. Bijan Amini
Senior Vice President
Gulf Interstate
1233 West Loop South
P. O. Box 56288
Houston, Texas 77027

Subject: Monthly Contract Status Report No. 4, "Buried Pipe Detection",
Project A-3065; covering the period of July 1982.

Gentlemen:

This monthly status report indicates the activities on the Buried Pipe Detection project for the month of July, 1982. The main activities during July consisted of the testing of the new 120 MHz transmitter, continuation of fabrication of the second signal conditioning unit, extensive measurements of the completed truck mounted system with Gulf Interstate personnel and a visit by C. T. Wells, President, and B. K. Amini, Senior Vice President of Gulf Interstate, for a project review.

Signal Conditioning Unit

Testing and trouble-shooting of four of the six circuit boards for the unit has been completed. The front panel wiring has been done and tested. The unit currently has the capability to digitize and format data and communicate with the APPLE computer.

Extensive Testing and Measurements

Transmitter/power supply noise problems have been minimized by extensive filtering. The testing of the 120 MHz transmitter revealed that an excellent match is made to the GSSI 120 MHz antenna by using the Georgia Tech Balun.

Page 2 -

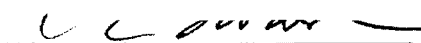
Status Report No. 4 for
period of July, 1982

Measurements indicated that pipes buried at a depth of 9.5 feet can be seen consistently in wet clay soil with the GSSI antenna configuration. In addition, the GSSI antenna can be raised up to 18" off the ground with only a small signal degradation.

Respectfully submitted,

William J. Steinway
Project Director

Approved:


C. E. Brown, Chief
Development Division
Radar & Instrumentation
Laboratory

WJS:mh



ENGINEERING EXPERIMENT STATION
Georgia Institute of Technology
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01 September 1982

Mr. Bijan Amini
Senior Vice President
Gulf Interstate
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P.O. Box 56288
Houston, Texas 77027

Subject: Monthly Contract Status Report No. 5, "Buried Pipe Detection".
Project A-3065, covering the period of August 1982.

Gentlemen:

This monthly status report covers the period from August 1 to August 31, 1982. The primary activities during the month included building of spare 300 MHz and 120 MHz transmitters; demonstrations of the 1 GHz short pulse radar in Houston, and cutting back of the program effort to minimum level.

Program Cutback

In order to allow Gulf Interstate to assess the market for the 300 MHz/120 MHz radar, the program for constructing the second and third radar units has been temporarily suspended. As per sponsor request, only work supporting the building of transmitter spares and demonstration of the 1 GHz radar continued. These tasks were accomplished and work was totally suspended as of August 31.

Transmitter Spares

Transmitter spares were constructed for both 120 MHz and 300 MHz frequencies. Initial tests were conducted in Houston on 19 August and adjustments were necessary. The modifications were completed and transmitters shipped by August 31.

Page 2 -

Status Report No. 5 for
period of August 1982 (continued)

1 GHz Radar Demonstration

The 1 GHz short pulse radar, owned by Georgia Tech was demonstrated in Houston on August 20. Measurements of concrete pavement thickness were made successfully. The unit was left in Houston pending further demonstrations and possible funding for construction of an operational highway version.

Respectfully submitted,

William J. Steinway
Project Director

Approved:

Charles E. Brown, Chief
Development Division
Radar and Instrumentation Laboratory



ENGINEERING EXPERIMENT STATION
Georgia Institute of Technology
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Atlanta, Georgia 30332

30 September 1982

Mr. Bijan Amini
Senior Vice President
Gulf Interstate
1233 West Loop South
P.O. Box 56288
Houston, Texas 77027

Subject: Monthly Contract Status Report No. 6, "Buried Pipe Detection".
Project A-3065, covering the period of September 1982.

Gentlemen:

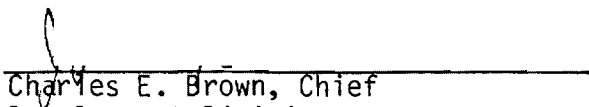
This monthly status report covers the period from September 1 through September 30, 1982.

In order to allow Gulf Interstate to assess the market for the 300 MHz-120 MHz radar, the program for constructing the second and third radar units has been temporarily suspended by sponsor request. A small amount of paper work and shipping of equipment to Houston were the only activities.

Respectfully submitted,


William J. Steinway
Project Director

Approved:


Charles E. Brown, Chief
Development Division
Radar and Instrumentation Laboratory

WJS:mh